Development of Data Base Integrated Hydrological- and Hydraulic Modeling for River Flood- and Urban Inundation Forecast

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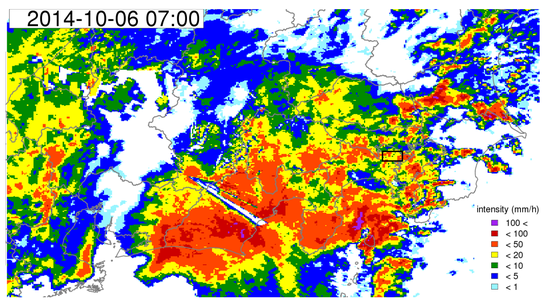
Background and Objectives

Coastal cities are vulnerable to **river flood, urban inundation, and storm surges**. Numerical simulation of such a complex hydraulic behavior would require **seamless integration of corresponding models**. Also forecasting water hazards on a real-time basis would require effective framework to exchange data input/output among models. Objectives of the present study is to propose state of the art **early warning system against water-related hazards via data archive and model integrated frame work.** Yokohama area is selected as a target site for this study.

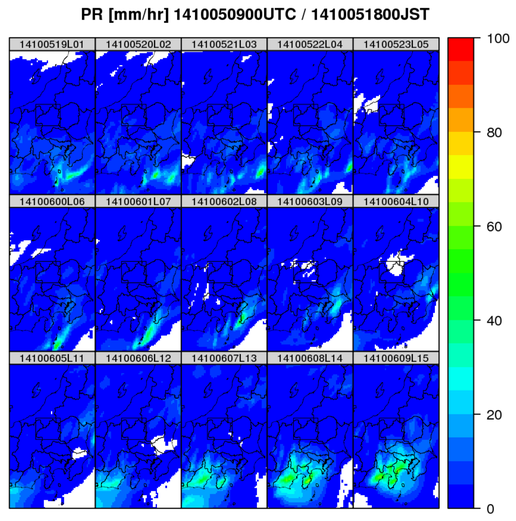
R Application in this study

- Numerical models employed in the system are written mostly in FORTRAN
- R scripts are applied mainly for geospatial data conversion of misc. data, e.g. radar rainfall, numerical weather prediction, etc.
- Pre-processing of data and post-processing of model output for visualization (see below)
- Numerical models and R-based scripts are wrapped by LINUX scripts and processes are automated



Ground radar-observed rainfall data with spatiotemporal resolution1km and 5 min (upper)

Numerical weather prediction of rainfall showing up to 15 hours of lead time (right)

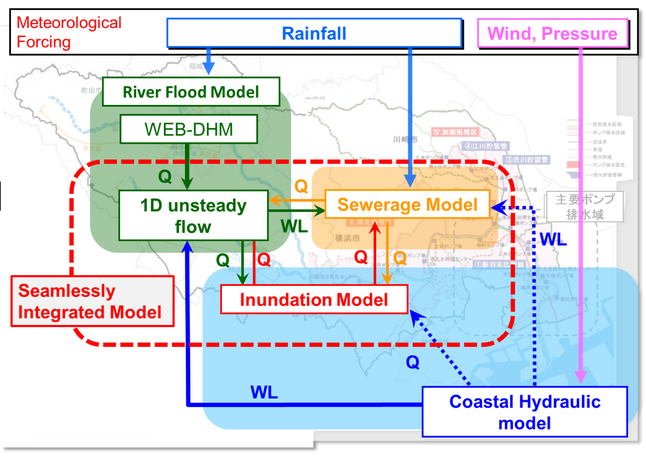


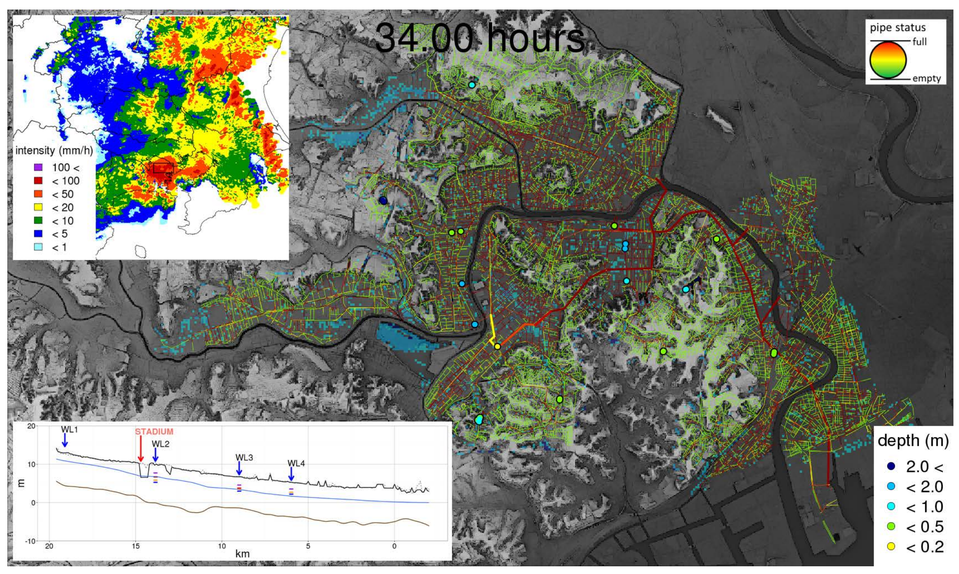
Model Integration to the Data Archive

☐ Seamlessly Integrated Model:

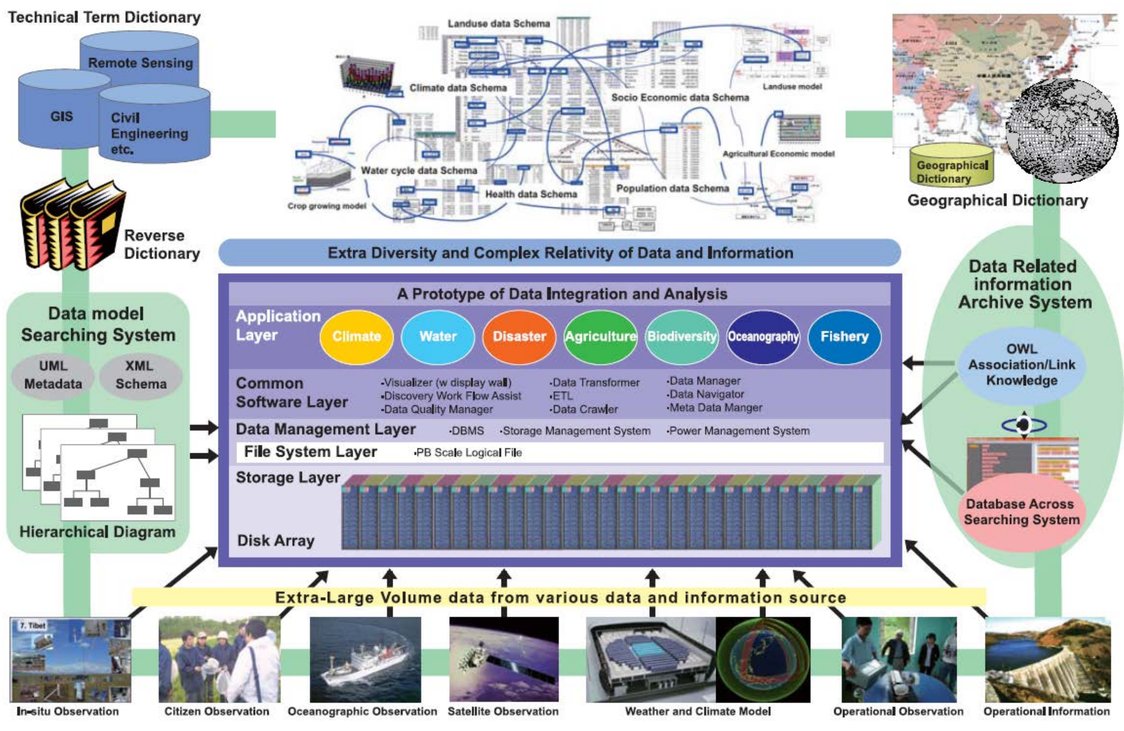
- ➢ 1D river flood model
- ➢ Sewerage network model
- ➢ Inundation model

With boundary condition from upstream rivers and the river outlets





Simulated urban inundation by the data-archive integrated model at the typhoon Phanfone 2014. The map shows drainage network status of flow capacity where darker red colors indicate full capacity and dots indicate drained water may flow out through manholes. It also shows the ground radar-observed rainfall data (upper left) and river water level (lower left). Visualization is done in R environment with fields, ggplot2, grid, raster, rgdal, rgeos, libraries



☐ **Data Integration and Analysis System (DIAS)** www.diasjp.net

- Japanese national project for delivering information for solving earth environment related issues by integration of massive observational and model data
- 25PB storage & 120 nodes (16 cores each) computing clusters for storing and analyzing IPCC CMIP3/CMIP5, satellite data, numerical weather prediction, ground radar rainfall, etc.

Summary

- Ongoing development of the early warning system by embedding the seamlessly integrated model to the massive data archive
- Intended to support the city managers' decision making - from expert judgement to quantitative information backed up judgement
- Introducing machine learning to the system, e.g. water level prediction, may increase accuracy of the model prediction leading to effective flood countermeasures

References

Y. Shibuo et al., Implementation of real-time flood prediction and its application to dam operations by data integration analysis system, J. Disaster Research (2016).

S. Lee et al., Long term monitoring of water level in sewer networks for validation of urban flood model,14th IWA/IAHR International Conference on Urban Drainage, 2017 (submitted).